New generations in “Better for you” Tortillas:

Protein-Rich, Reduced Sugar and Gluten-Free Options

Canan Ozer

Principal Food Technologist, Protein Fortification Applications

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A leading global, plant-based ingredient solutions provider

18,000

Customers in nearly **120 countries**

70%

2023 global new product launches **contain ingredients Ingredion produces**[2]

32

Ingredion Idea Labs® **innovation centers**

~500

Global food technology **R&D scientists**

Large and diversified ingredients business with customers globally across consumer and industrial categories

100%

Tier 1 crops **sustainably sourced** by 2025[1]

12,000

Talented and engaged **employees**

Headquartered **outside Chicago**

INGR
LISTED
NYSE

Listed **122** years

1. Tier 1 crops are corn, tapioca, potato, stevia and pulses; 2. Innova 2023; includes: starches, modified starches, sugar & syrups, high-intensity sweeteners, fibers, flours, plant-based proteins, thickeners, and assorted fruit and vegetable essences, juices, & purees

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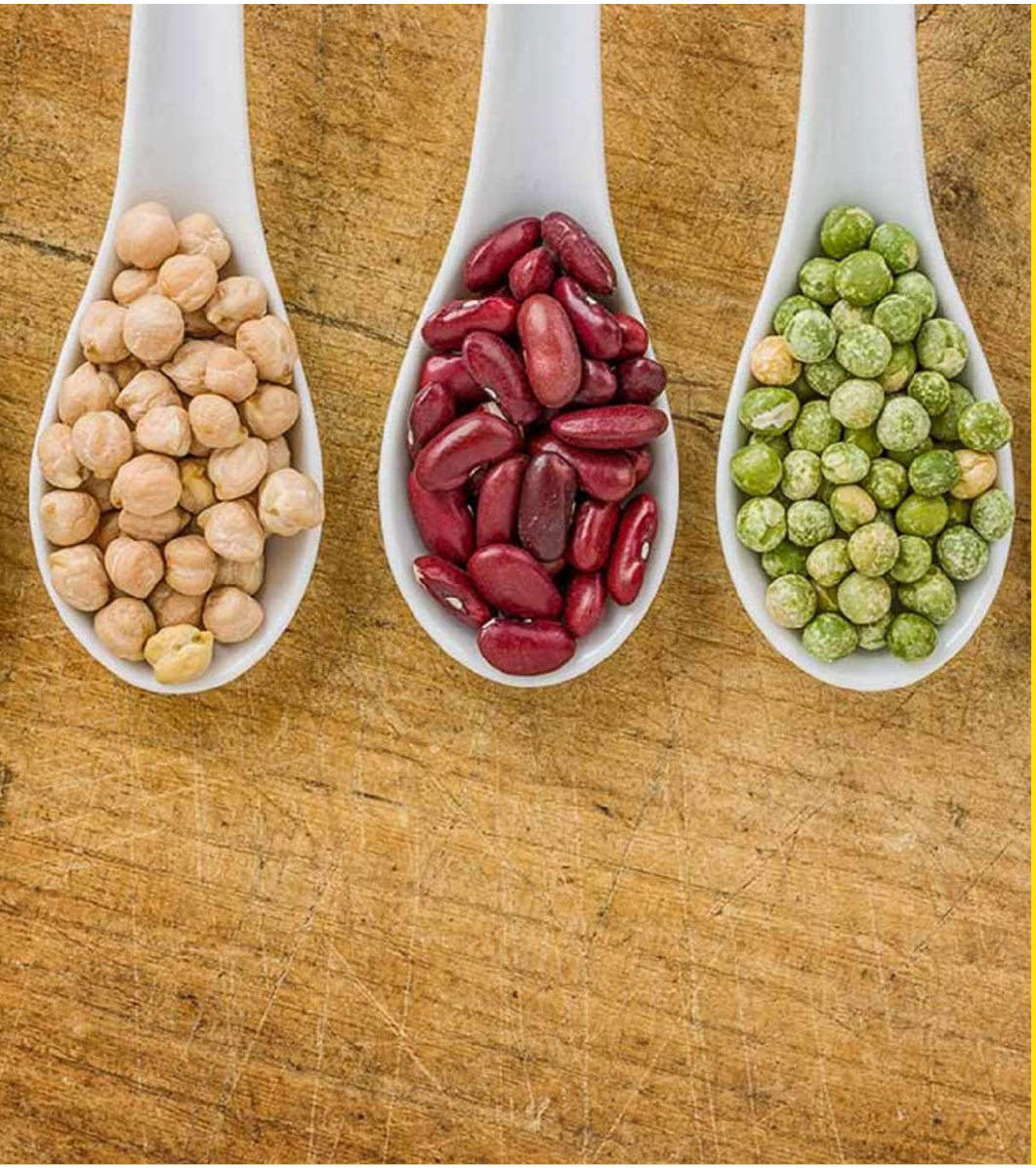

Pulses are part of legumes family- helping enable on-trend claims for top customer appeal

- Protein
- Fiber
- Clean label
- Gluten-free at the source
- Wheat-free at the source
- Non-GMO

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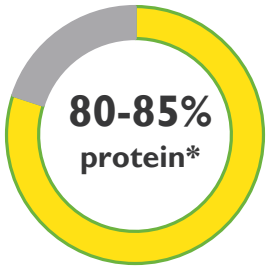
Pulse ingredients are nutrition power houses for BFY tortillas

Isolates

Pea

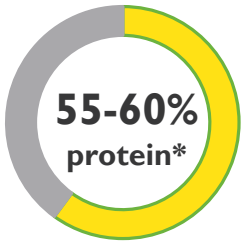


High level of protein to enable "excellent source of protein" claims

- Up to 15% of wheat flour
- 7-9gr protein per serving (49gr)
- Increasing PDCAAS (Protein Digestibility-Corrected Amino Acid Score)

Concentrates

Lentil, pea and faba bean

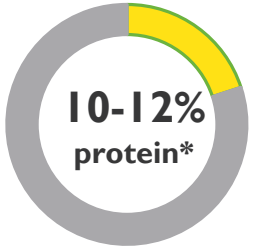


Deliver balanced nutrition, fiber and macronutrients along with in-demand protein

- Up to 20-30% of wheat flour
- Increasing PDCAAS (complete protein score)
- Dietary fiber (12-17%)
- Micronutrients (K, Ca, Na, Fe, B-9)

Pulse flours

Lentil, pea, chickpea and faba bean



Clean label, gluten-free replacement for other flours and starches

- Up to 50% of the total flour in GF tortilla formula
- Dietary fiber (6-8%)
- Micronutrients (K, Ca, Na, Fe, B-9)

*Dry basis

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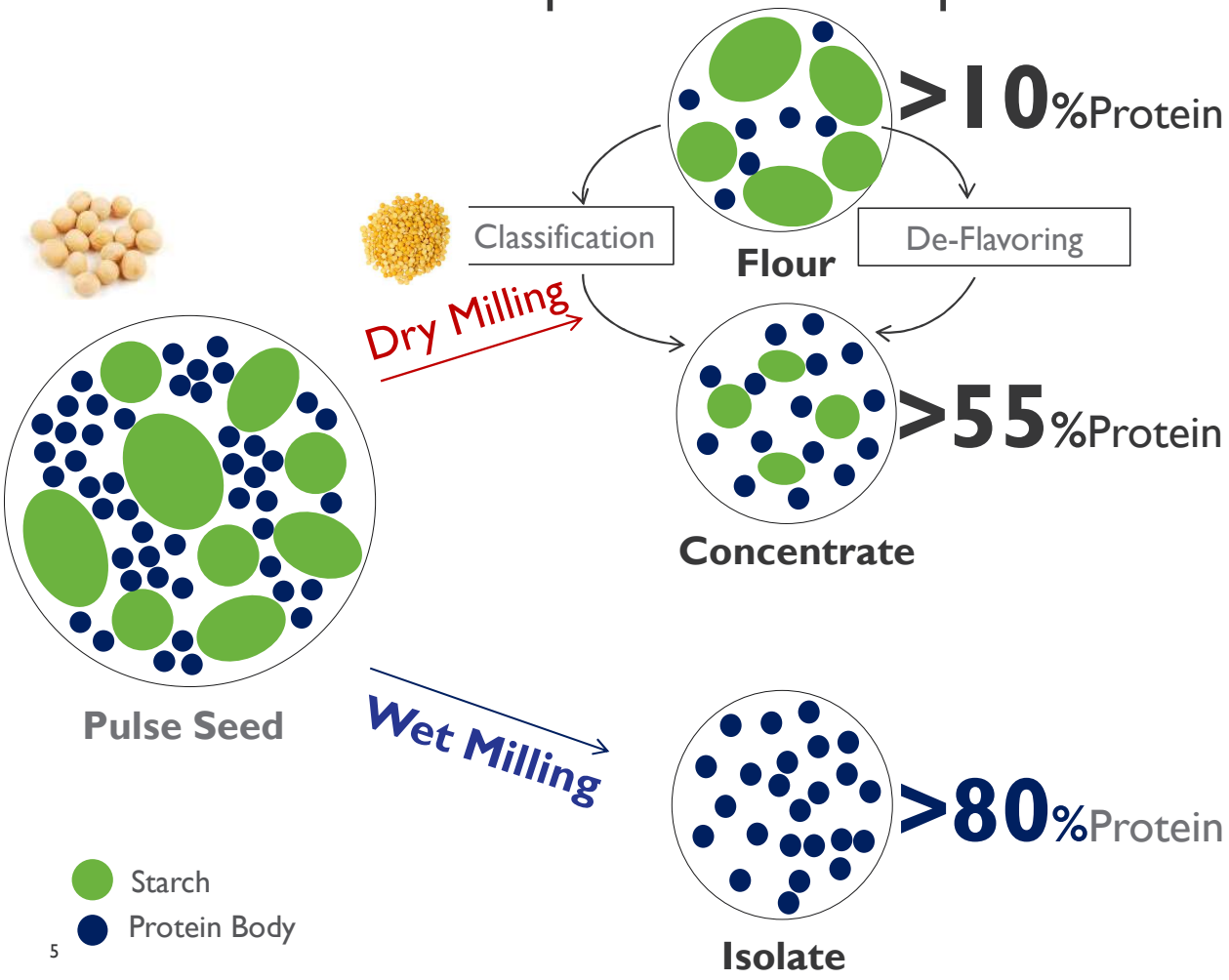
Fractionation of pulses has an impact on functionality



Air Classification:

- Gentle process, protein and starch remain intact

De- Flavoring

- Mild process, minimal protein & starch damage
- Improved Functional Properties
  - Pasting viscosity
  - Starches more resistant to retrogradation which is important for shelf life
- RTE status (good for dusting)
- Ingredion holds the Proprietary technology

Wet Milling:

- Creates changes in protein structure

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Water holding capacity

Impacts of different fraction method

An equal quantity of pulse ingredients hydrated in an equal amount of water

➢The amount of water needed to achieve the same consistency differs for isolates, concentrates, and flours

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Flour Tortillas

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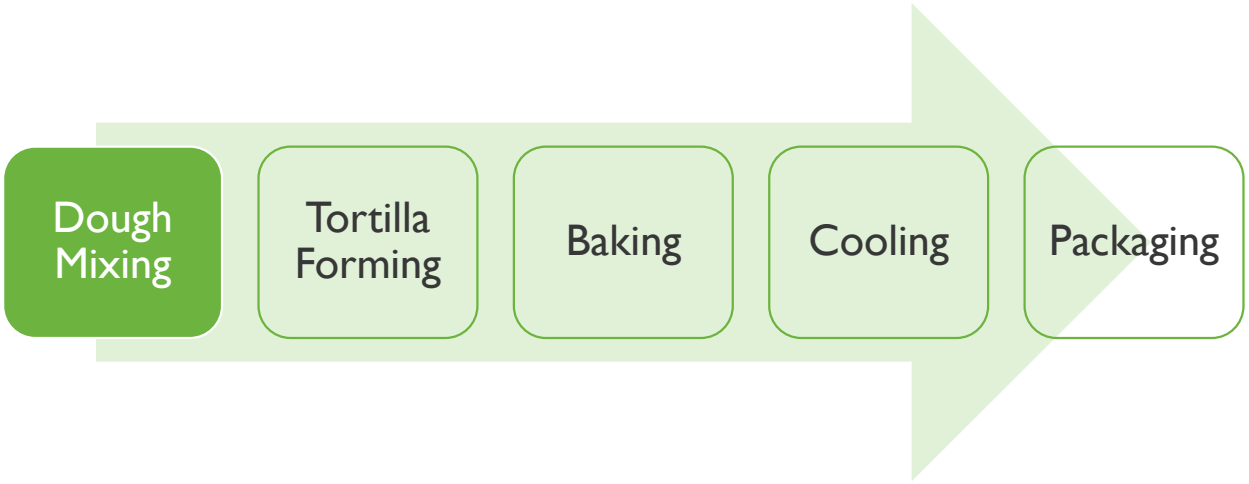
Basic tortilla manufacturing steps



Happy tortilla depending on each step

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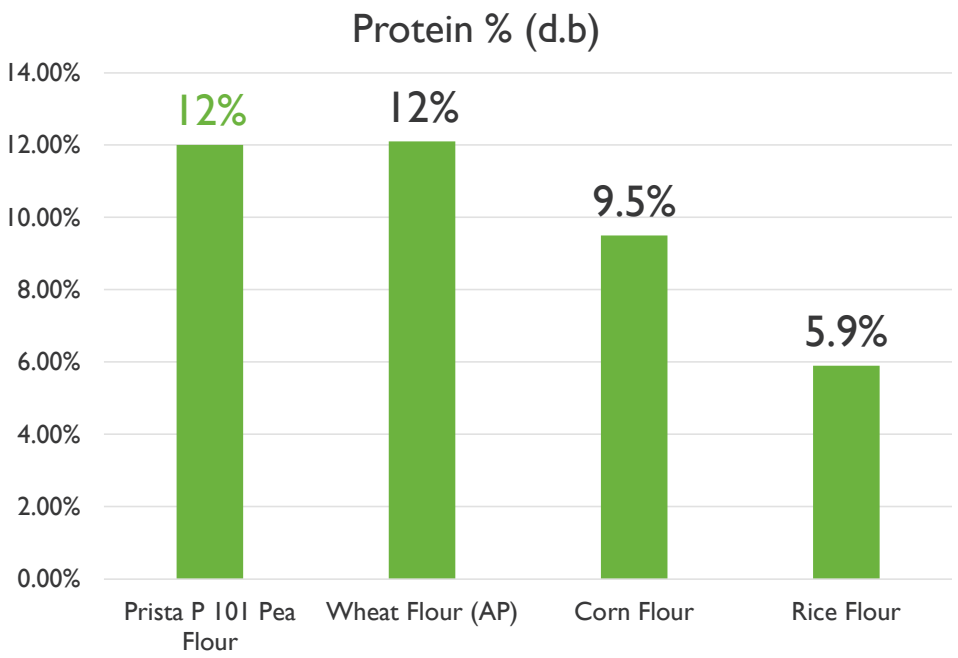
Pulse flour has similar/higher protein content as wheat flour, but…



…very different protein composition

Pulses	Protein fractions	Wheat
10 – 30%	Albumin	5 – 15%
40 – 80%	Globulin	5 – 10%
10%	Glutelin	30 – 50%
0 – 5%	Prolamin	30 – 50%

≈ 80% soluble protein

≈ 80% insoluble protein

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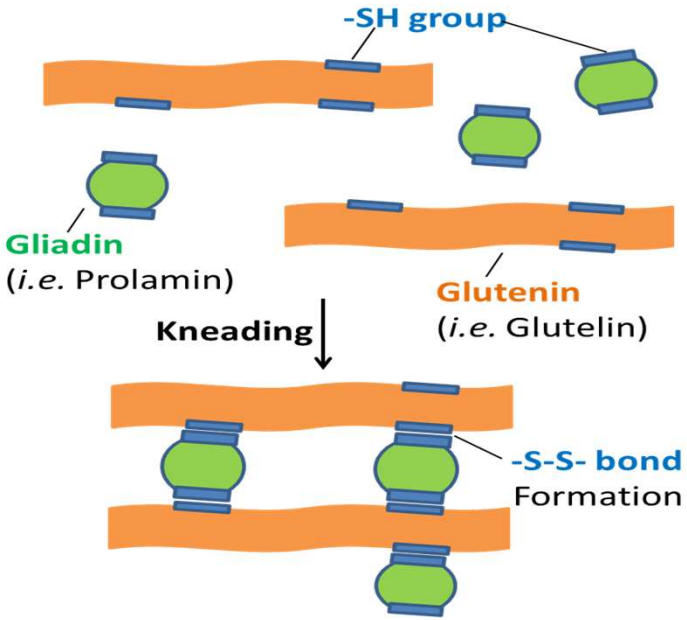
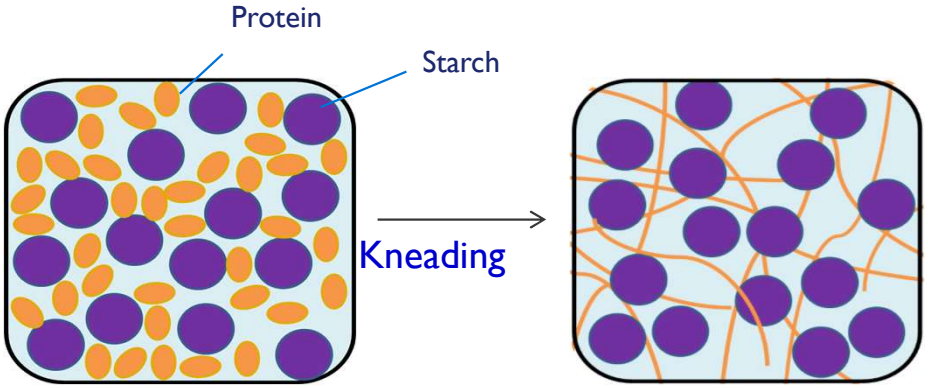
Impact of protein composition in gluten formation





- Glutenin responsible for elasticity and strength
- Gliadin responsible for extensibility

- Wheat protein is high in cysteine content
  - Disulfide bond formation
- **Plant/pulse protein is low in cysteine content**
  - **Limited disulfide bond formation**

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Challenges in plant-based protein enhanced tortilla

PROCESSING	TEXTURE, TASTE, APPEARANCE
• Firmer dough (higher hydration requirement) • Longer mixing time • Less cohesiveness during mixing • Difficulties in processability and machinability	• Dry, gritty, and tough texture • Smaller diameter due to firmer dough and lack of • Poor rollability cracking texture elasticity • Off flavor

Case study-
Pea Protein Isolates in Tortillas

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Use of pulses in protein enhanced tortillas

Regular tortilla

Servings per Package	10
Amount per Serving	
Calories 140	**Calories from Fat** 30
	% Daily Value*
Total Fat 3.5g	5%
Saturated Fat 1.5g	8%
Trans Fat 0g	
Polyunsaturated Fat 0g	
Monounsaturated Fat 1g	
Cholesterol 0mg	0%
Sodium 420mg	18%
Total Carbohydrate 24g	8%
Dietary Fiber 1g	4%
Sugars 1g	
Protein 4g	
Vitamin A 0% *	Vitamin C 0%
Calcium 8% *	Iron 8%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

Protein enhanced tortilla

	1 Tortilla (49g)
Calories	90
	%
Total Fat 2g	3%
Saturated Fat 0g	0%
Trans Fat 0	
Cholesterol 0mg	0%
Sodium 240mg	10%
Total Carbohydrate 15g	5%
Dietary Fiber 6g	21%
Total Sugars 0g	
Includes 0g Added Sugars	0%
Protein 9g	
Vitamin D 0µg	0%
Calcium 70mg	6%
Iron 1.7mg	10%
Potassium 150mg	3%

Case study:

- 13% protein enhanced formula
- No moisture adjustment

- Used 3 different pea protein isolates
  - with same amount of protein content (80%)
  - with different WHC and solubility properties

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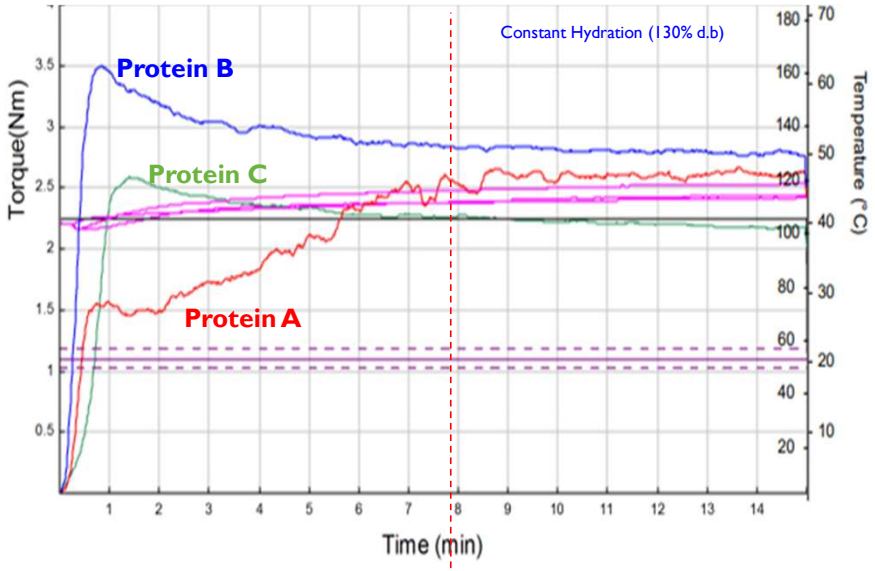
Protein isolates are NOT interchangeable 1:1

*Color, WHC and solubility differs for each protein as result of different source or extraction conditions



- Part1 :Water absorption and hydration capacity
  - Max Torque: Max Dough consistency at initial hydration and dough formation.

The higher max torque, the more water is absorbed by protein

- Part 2 : Dough consistency stability during mixing
  - Stability: Linear plateau shows stabile dough consistency during mixing
  - End Torque: Final dough consistency after fully hydration

The higher end torque indicates the more water absorption capability as well as firmer dough

Pea Protein A
80% d.b

Pea Protein B
80%d.b

Pea Protein C
80% d.b

- Challenges on 1:1 replacement
  - Stiff dough consistency (DC) (Protein B DC > Protein C DC> Protein A DC)
  - Tearing or breaking apart (due to lack of enough hydration)
  - Sticking to bowl sides (due to lack of enough mixing)
  - Smaller diameter or jagged/cracked edges
  - Reducing extensibility and increasing toughness
- Solution
  - Moisture adjustment
  - Longer mixing time adjustment

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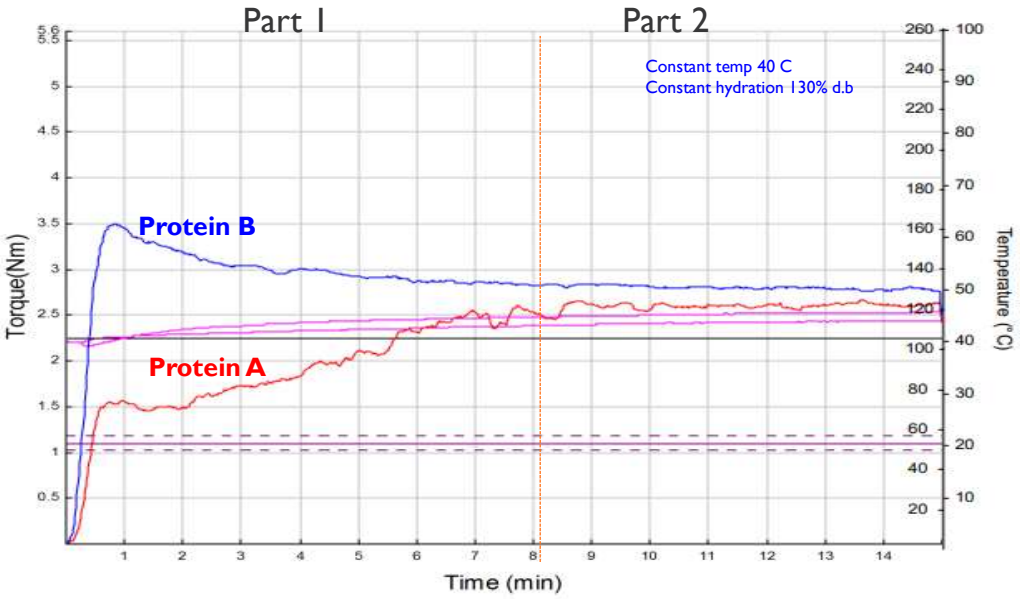
Continued…



All has same protein content
~80% d.b

Pea protein A	Pea protein B
High solubility	Low Solubility
Low WHC	High WHC

Solubility and WHC have an impact on dough consistency

- When protein has lower WHC and solubility, it exhibits softer dough

- There is no moisture adjustment in tortilla formulation, but proteins have similar moisture
- 13% Wheat flour replacement

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Ingredion's tortilla solutions

Wheat-Containing Tortillas

What ingredients are needed?	For what challenge?
Hydrocolloids **Ticaloid® Tortilla** (Cellulose gum, guar gum, xanthan gum) **Ticaloid® Fold N Flex** (Guar Gum, Sodium Alginate)	• Dough viscosity control • Texture modifier • Prevent staling • Freeze/thaw stability
Functional fibers **HI-MAIZE® 260 resistant corn starch**	Nutritional claims
Plant-based proteins **VITESSENCE® Prista P 360 faba bean concentrate** **VITESSENCE® Prista P 155 pea concentrate** **VITESSENCE® Pulse 1803C pea protein isolate** **VITESSENCE® Pulse 1853 pea protein isolate**	Nutritional content with cleaner taste

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Case study-
GF and Sugar Reduced Tortillas

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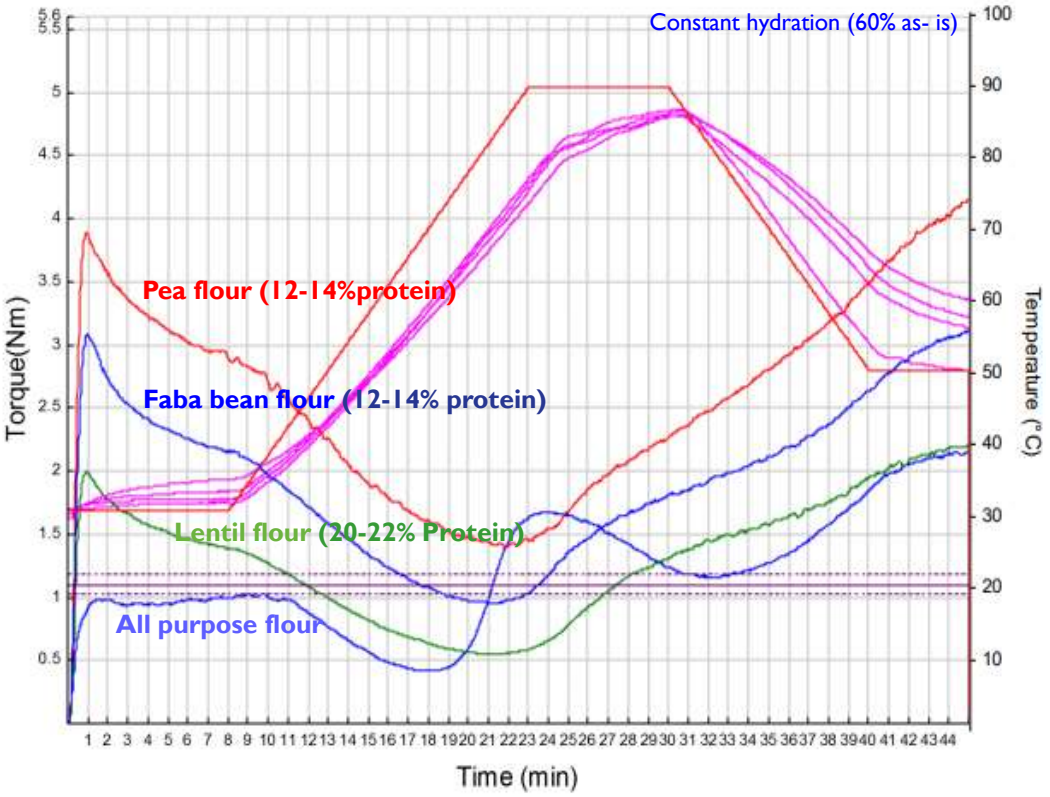
Challenges in gluten-free tortilla product formulation

PROCESSING	TEXTURE, TASTE, APPEARANCE	SHELF LIFE	NUTRITION PROFILE
• Lack of viscosity or elasticity compared to the wheat-containing dough, leading to difficulties in processability and machinability	• Poor rollability • Dry, powdery, and rubbery texture • Poor surface color • Off flavor	• Shorter shelf life • Increased staling rates due to increased water mobility	• Lack of protein, nutrients and fiber • Use of high levels of sugars and fats to mask the texture and flavor challenges

Impact of different pulse flour composition in water absorption



Example: *Lentils have lower water absorption and water-holding capacity (WHC) compared to other legumes like peas and faba beans due to several factors*

1. *The types of proteins differ*
2. *Unique fiber composition*
3. *The physical structure of lentil flour*

Water absorption varies depending on the composition of the flour base.

*Applied same hydration to achieve different dough consistency
**De-flavored flours are used in this study

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Use of pulses in BFY gluten-free tortillas

Gluten-free tortillas with an enhanced nutrition profile that deliver the taste and texture of wheat-based versions

Modified tapioca starch mimics the functionality of wheat flour in gluten-free products

Chickpea flour is a gluten-free, pulse-based flour. Adds color to the tortilla and improves nutrition

Pre-gelled modified tapioca starch is a high-performance cold water swelling modified food starch derived from tapioca; it exhibits many of the properties of a modified cook-up starch and possesses a very bland flavor profile with good mouth melt-away characteristics

Faba bean protein concentrate helps with dough handling, adds color, improves elasticity and tortilla resilience

Ingredients	Bakers%
Modified tapioca starch	37.10
Chickpea flour	14.00
Pregelatinized modified tapioca starch	6.00
Faba bean protein concentrate	1.69
Water	30.00
Vegetable oil	8.52
Salt	0.69
Sugar	0.92
Glycerine	1.00
Xanthan gum	0.08
Totals	**100.00**

Nutrition Facts

1 Serving per Container

Serving size	**1 Tortilla (49g)**
Amount per serving	
Calories	**140**
	% Daily Value*
Total Fat 4.5g	6%
Saturated Fat 0.5g	3%
Trans Fat 0	
Cholesterol 0mg	0%
Sodium 140mg	6%
Total Carbohydrate 24g	9%
Dietary Fiber 0g	0%
Total Sugars 0g	
Includes 0g Added Sugars	0%
Protein 2g	
Vitamin D 0µg	0%
Calcium 9mg	0%
Iron 0.4mg	2%
Potassium 90mg	2%

*The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Ingredients: Modified starch, (Rice, tapioca, corn starch), water, chickpea flour, tapioca starch, vegetable oil, faba bean concentrate, glycerin, sugar, salt, xanthan gum

Gluten-free challenges: texture, taste, and appearance

Regular tortillas

- Good rollability
- Moist and cohesive texture
- Light yellowish color with small brown blisters on the surface
- Opaque
- Hearty flavor

Gluten-free tortillas

- Poor rollability
- Dry, powdery, and rubbery texture
- Poor surface color with large blisters
- Translucent
- Off flavor

Gluten-free tortillas with pulses

- Improved rollability and extensibility
- Surface color improvement (toast-marked and blistering)
- Opaque appearance
- Improved flavor and cohesive texture

Gluten-free tortillas with allulose

- Improved toughness
- Improved extensibility
- Improved flexibility (Good rollability)

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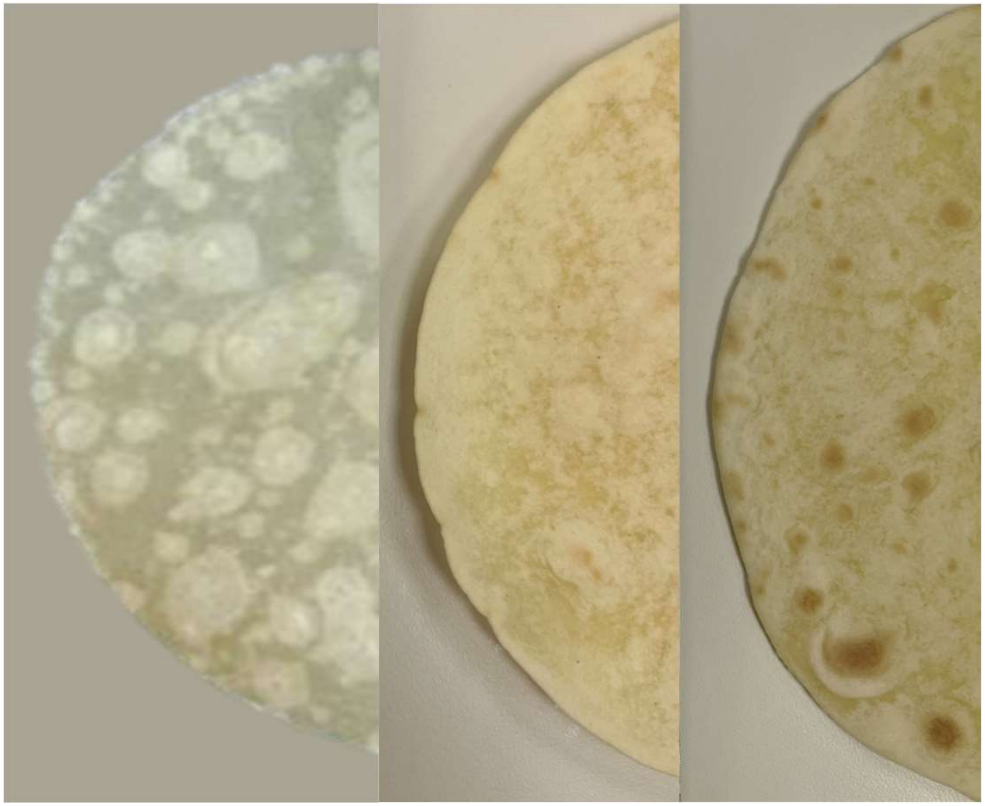
Use of allulose in gluten-free tortillas



Regular Gluten-free tortilla

50% Gluten-free flour replacement with pulses

50% Gluten-free flour replacement with pulses
+
Sugar replacement with crystalline Allulose

- Allulose
  - Improve extensibility, toughness and adds more toasted marks to GF tortillas
  - Used in low carb or Keto-friendly tortillas to enhance color without adding calories or sugars to the nutritional panel color with calorie

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Ingredion's tortilla solutions

"Gluten-Free" Tortilla

What ingredients are needed?	For what challenge?
Gluten-Free Bulk Flour **PENTECH® GF TTB System** **HOMECRAFT® Create GF 10 and 20 functional flours** (Rice Flour, Tapioca Flour) **HOMECRAFT® Prista Flours** (Pea, faba bean and lentil)	• Bulk/backbone of the recipe • Texture modifier: body, elasticity and chewiness, crumb structure
Starches **HOMECRAFT® Express 390 tapioca corn**	• Moisture retention • Shelf-life extension, • Freeze-Thaw Stability • Texture differentiation
Plant-based proteins **VITESSENCE® Prista P 360 faba bean concentrate** **VITESSENCE® Pulse 1853 Pea protein isolate**	• Build structure • Color development • Texture
Hydrocolloids **Ticaxan ® Xanthan VI** (Xanthan gum) **Ticagel ® Bind KX** (Konjac, xanthan gum)	• Shelf-life stability • Moisture retention • Structural integrity
Functional fibers **HI-MAIZE® 260 Resistant Starch**	• Nutritional claims

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Pulse ingredients can help you to differentiate your product in rapidly growing market

✓Nutritious Gluten-free tortillas with excellent appearance, texture, mouthfeel and shelf life.
✓Plant-based protein enhanced tortillas with excellent texture, shelf life and clean flavor
✓Developing new, trendy products leveraging deep Ingredion expertise.

Innovate with us!

Ingredion
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Danke Sehr!
Obrigado
Teşekkürler
MERCI BEAUCOUP
謝謝你
E SE GAN AN NI
GRACIAS
감사합니다
GRAZIE
धन्यवाद
THANK YOU